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HETEROCEPHALUS, THE REMARKABLE AFRICAN BURROWING RODENT

BY
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HETEROCEPHALUS, THE REMARKABLE AFRICAN BURROWING RODENT.

By W. J. Hamilton, Jr.
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The curious hairless rodent, *Heterocephalus,* peculiar to eastern Africa, has been known for nearly one hundred years, but very few specimens are represented in museums. The species was described by Ruppell in 1845 from a single individual. The next reached the British Museum forty years later, and a short time later, the Civic Museum of Genoa secured a number of these rodents. Very few specimens are represented in the collections of this country. A single individual of the Naked Rat, collected in British East Africa by Glover M. Allen, is in the Museum of Comparative Zoology. In 1912 the National Museum secured twelve specimens of *Heterocephalus* from the Rainey African Expedition. Mrs. Delia J. Akeley, in charge of the Brooklyn Museum Expedition, collected two *Heterocephalus* in Kenya Colony, British East Africa, in 1925. Through the kindness of Mr. George P. Engelhardt, Curator, Department Natural Science, I have been permitted to make a study of these peculiar rodents.

External Features.

Heterocephalus is a small rodent, appearing in general form somewhat like the red-backed mouse, *Evotomys.* The naked appearance, due to the almost total lack of hair, and the large protruding incisors, give a rather unpleasant appearance to the animal. The entire body is wrinkled. This is not due entirely to the action of the preservative, as Capt. Bottego (Parona and Cattaneo, 1893) has commented on this condition in living animals. The color in preserved specimens is a lead hue dorsally, grading into flesh color on the belly. Bottego states that the live specimens are reddish.

The head is short and chunky, the protruding incisors giving the animal quite a ferocious appearance. The upper lip, like that of many

burrowing rodents, passes across the mouth opening under the incisors. The minute eye measures 1.3 mm. in diameter and is surrounded by fleshy lids. There is no external ear, the simple opening occurring well behind the eye. The external nares are small and set close together, directly above the base of the incisors.

The neck is short and thick. The pes and manus of the short legs are supplied with stiff hairs, arising from the sides of the toes. The function of these in such a fossorial mammal as *Heterocephalus* is quite obvious, as Thomas (1885) has pointed out. The tail is not quite half the length of the head and body.

Perhaps the most remarkable characteristic of this rodent is the almost total absence of hair. Vibrissae are prominent about the lips, while the chin and throat, as well as the forehead and crown, are without a vestige of hair. There is a single superciliary vibrissa. Three prominent genal vibrissae appear slightly ventrad to a line drawn from the eye to the ear. These arise from a prominent "wart." Single hairs arise from warts here and there about the back and venter, with no apparent regard to order. The tail contains twenty-two hairs in both specimens examined. The integument is exceedingly thin, almost paper-like in texture.

External Measurements of the Two Brooklyn Museum Specimens.

	No. 1394 fem. adult	No. 1395 fem. adult
Head and Body	87 mm.	84 mm.
Tail	38 mm.	39 mm.
Hind Foot	20 mm.	20 mm.
Forearm and Hand	26 mm.	25 mm.
Muzzle to Eye	8.8 mm.	9 mm.
Muzzle to Ear	19.5 mm.	18.7 mm.
Eye to Ear	9 mm.	8 mm.

Skull.

The skull of *Heterocephalus* has been described in some detail by the Italian workers, Parona and Cattaneo. It seems hardly necessary to dwell at any length on this. It seems desirable to list some measurements, however, as they differ slightly from those of other writers.

Front of nasals to junction of sagittal and lamboidal crest, 15.5 mm.; nasals, 6.6 mm. by 3 mm.; palate length, 11 mm.; interorbital breadth, 6 mm.; combined length of cheek teeth, 3 mm.; intertemporal breadth,

6.3 mm.; diastema, 7 mm.; lower jaw, back of angle to front of symphysis, 11.6 mm.

Teeth.

Tooth Formula. $I.\frac{1}{1}$, $C.\frac{0}{0}$, $P.\frac{0}{0}$, $M.\frac{3}{3} \times 2 = 16$.

The incisors in both the upper and lower jaw are long and protruding, being very sharply pointed. They are modified to play an important rôle in digging. The distance between the two rows of simple round molars in the upper jaw is 2 mm. The crowns of the molariform teeth of both the upper and lower jaws are figured in Plate II.

Vertebral Column.

The usual seven cervical vertebrae are present. The atlas, articulating with the skull, has a greater transverse than a vertical diameter. It measures 8 mm. in width and 5 mm. in height. The neural spine, while present, is rudimentary. The neural arch is not greatly curved and somewhat weaker than the ventral arch. The transverse processes are flattened and short. The transverse foramen is visible.

The axis is 5 mm. wide and the greatest height, from the odontoid process to the tip of the neural spine, is 6 mm. The odontoid process is well developed and extends craniad from the inferior arch. The neural spine is likewise well developed, constricted somewhat in its middle and expanded at its dorsal extremity. It turns slightly caudad.

The second to fifth cervical vertebrae show no marked variation from the usual form. The third has a trace of a neural spine. Unfortunately the fourth and fifth neural arches were destroyed when the animal was speared.

The eleven thoracic vertebrae measure 24 mm. along the dorsum. The slender neural spines are longest in the first six and directed caudad, short in the seventh and eighth and lacking in the last three thoracic vertebrae. The transverse processes are well developed, more so in the first than in the last.

The lumbar vertebrae number seven, with a dorsal length of 22 mm. The fourth, fifth and sixth are slightly longer than the others. The seventh is the smallest. Spinous processes are small.

The five sacral vertebrae have a total length of 13 mm. A small neural spine is present on the first four.

Caudal vertebrae number nine. The third, fourth and fifth are the

longest, the others shortening cephalad and caudad. The total length of these vertebrae are 35 mm.

Sternum.

The sternum is composed of the manubrium, four sternebrae and the xiphoid process. The total length is 19 mm. This is considerably longer than is found in the larger *Heterocephalus glaber* which the Italian workers studied. The manubrium is 4 mm. wide and without a keel. The lack of a keel, a structure associated with burrowing mammals, and partiticularly the Talpidae, is not surprising when we consider the manner in which *Heterocephalus* digs. It uses its feet very little in digging, the head and strong incisors being used primarily for this purpose. Indeed, in such a strong digger as the pocket gopher, *Geomys,* only a trace of a keel is found.

The first sternebra is a third longer than the manubrium and each of the others is slightly shorter than the one craniad to it. The xiphoid process extends caudad and on its caudal border is the round thin xiphoid process. This measures 5 mm. in diameter.

Ribs.

Ten pairs of ribs join the sternum, while an eleventh pair is vestigial. Parona and Cattaneo record eleven pair of ribs, with a twelfth pair rudimentary. The ribs are considerably flattened from the lateral to the medial surface. Cartilages from the distal end unite the first four ribs separately to the sternum. The cartilage portion of the fifth to tenth ribs inclusive join together to meet the sternum at a common point. A short cartilage strip extends from the atrophied eleventh rib.

Pectoral Girdle.

The small scapula is roughly triangular. Its greatest length is 12 mm. and its greatest width 6 mm. The lateral surface of the scapula is divided into two parts by the spine; the cephalic supraspinous portion is much smaller than the caudal infraspinous fossa, occupying approximately one third of the lateral surface. The coracoid process is rather long and curves cephalo-ventrad.

The scapular spine is rather peculiar in this form. It originates slightly craniad from the middle of the vertebral border. It then passes cephalo-ventrad for a short distance, then forms a gentle curve with the convex side cephalad and terminates slightly below the coracoid process in a broadened acromial process.

The slender clavicle is 10 mm. It articulates with the acromial process and is somewhat flattened at this point. The clavicle passes medially, curving twice before it ends in the rounded sternal termination.

Anterior Limb.

Humerus. The humerus, 12 mm. in length, articulates with the scapula at the glenoid cavity and the radius and ulna distally. This bone is flattened in a cephalo-caudad direction. A well-developed deltoid crest is present. The trochlea and the capitellum are of the same size.

Ulna. The ulna measures 12.5 mm. in length and curves toward the head. The greater sigmoid cavity receives the distal portion of the humerus. From here the olecranon process extends proximally for 3 mm.

The radius is 8.6 mm. in length and lies rather closely applied against the ulna. For half its length there is a space between it and the ulna. This is quite different from the situation found in the specimen studied by Parona and Cattaneo, where the two bones are so closely applied as to leave no room between them. The distal extremities of the radius and ulna are of the same size.

Hand. The bones of the carpus number six, and are closely joined by ligaments. Five slender metacarpals occur. The pollex is the shortest, this bone measuring only 1.5 mm. Next in length is the fifth, which is 2 mm. The second and fourth measure 4 mm., while the longest, the third, measures 5 mm.

Digits. The pollex has two phalanges, the remaining four have three each. Each digit possesses a minute nail. The first and fifth are 4 mm., the fourth is 6 mm., while the second and third are 7 mm. and 8 mm. respectively.

Pelvic Girdle.

The pelvic girdle is formed by the two innominate bones. These are joined to the first and second sacral vertebra. The bones of the pelvic girdle are so tightly fused that the sutures cannot be determined. The figure shows the general shape of this structure better than a written description.

Posterior Limb.

The femur is 13 mm. in length, flattened in a cephalo-caudad direction. The head, situated on the medial side, articulates with the acetabulum. The neck is not noticeably constricted. The greater trochanter is very distinct, but does not reach to the height of the articular head. It repre-

sents a continuation of the shaft. The lesser trochanter is small and disto-caudad to the head, on the medial surface. The lateral crest is not well developed. The trochlea is shallow.

The patella is large and well developed. It is rather pear-shaped, being 3 mm. in length. It fits close against the trochlea.

The tibia is 14 mm. This bone is flattened latero-mediad. There are two tuberosities on the proximal head. A prominent crest on the shaft is present.

The slender fibula, measuring 12.5 mm. is situated caudad to the tibia, except its most distal portion, which is laterad. It is separated from the tibia for its entire length. The head articulates directly to the lateral tuberosity of the tibia. The distal portion of the fibula terminates in the malleolus.

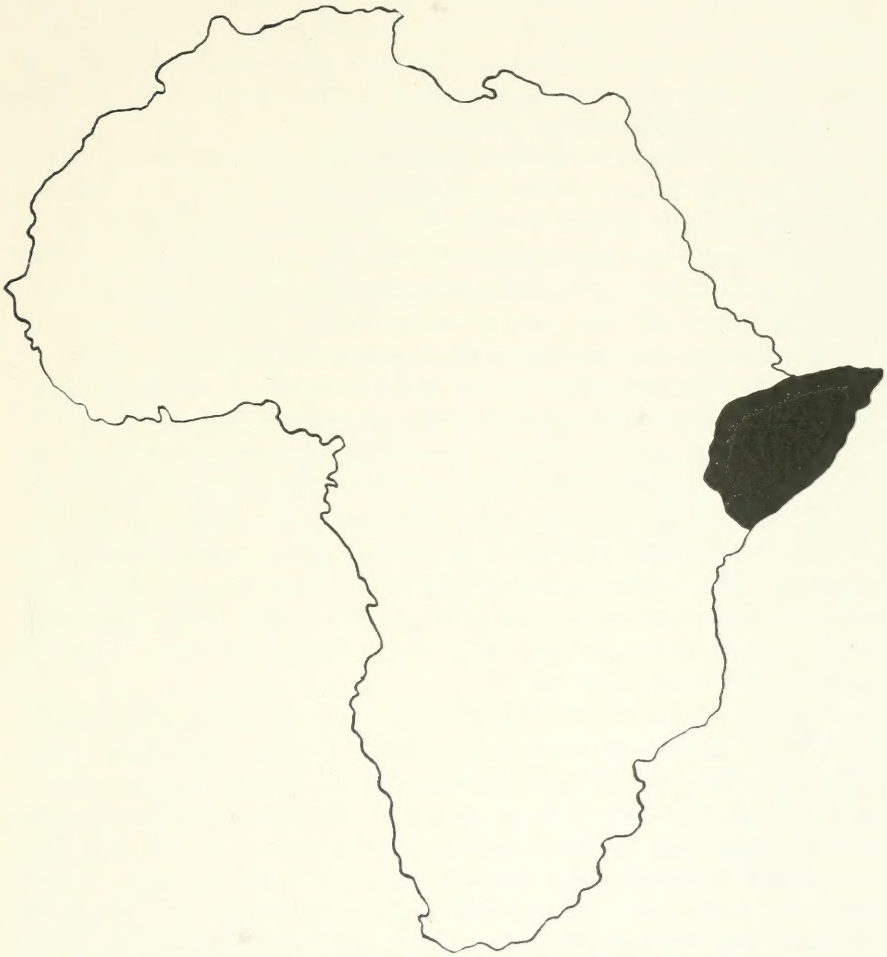
The tarsus is composed of eight bones. The calcaneum is the largest and next in size is the astragalus.

The metatarsus has five bones, the fifth being the shortest. This bone is 3 mm. in length, the first 4 mm., the second 4.5 mm., the third 7 mm. and the fourth is 6 mm. in its length. A pair of metatarso-pharyngeal sesamoid bones are located at the joint of each digit. There are three digits to each toe, except the pollex, which has only two. Each digit bears a short weak claw.

Distribution.

The habitat of *Heterocephalus* as given by Ruppell is the meadow valleys of Shoa, south of Abyssinia, where it lives in earthen cavities. Parona and Cattaneo give the range of this rodent as the whole of Somali from Berbera to the Juba River. The British Museum specimen of *H. ansorgei* was taken between Ngomeni and Kinani, Makindu country, British East Africa, while the Brooklyn Museum specimens, collected by Mrs. Delia J. Akeley, were taken west of the Kinna River, Kenya Colony, East Africa. Drake-Brockman (1910), speaking of the Naked Rat, says it is found in the coldest parts of Somaliland. This writer found it common on the Golis Range, and from there right away to Hargeisa and south into Haud. He has caught it as far south as Banissa, Gurre country, British East Africa.

Thus the range of the Naked Rat includes a considerable portion of East Africa from Berbera on the Gulf of Aden, through the better part of Abyssinia and all of Italian Somaliland as far south as southern British East Africa.



Map of Africa, showing distribution of the Rodent Genus *Heterocephalus*. Range is indicated in black.

Habits.

Heterocephalus is strictly fossorial in its habits. Drake-Brockman (1910) referring to *H. glaber* has this to say: "This peculiar rat lives in burrows under the ground. These burrows extend for great distances and have exits at intervals, through which the mud dug out during the burrowing is shot in jerks. These small tumuli look like miniature volcanoes when the earth is being shot out of them. The best way to get

specimens is to creep up softly to one of these 'active volcanoes,' when one can often see the hindlegs hard at work shooting out the mud. A good stout stick with a nail at the end or a small Somali spear can then be thrust in rapidly and the rat transfixed."

Writing of the same species, Capt. Bottego (Parona and Cattaneo, 1893) has this to say: "They snort lightly, almost like a new born pig and resemble them in their movements. They are very ferocious and if touched with a stick, open their mouths and leap on it and bite it, holding it tight between their teeth, with great strength. We put three of them in an enclosure and there was a regular battle. After more assaults, one bit the other and held him tighter than a bulldog holds a collie. I took one of those fighting by the tail, and suspended it in the air, but even with a few blows on the head, I could not separate them. It is a very irascible animal. When they are put alive into tubes, in order to kill them by covering with alcohol, they make incredible efforts not to be stuck in, and being stuck in, to get out. They swell very large. If they are tickled, they become so irritated as to turn from a light reddish to a purplish. The ventral surface of the body, when alive, is swelled and with this they almost touch the plane on which they walk. Excluding their nature and ferocity, they seem like an animal just born. They dig with the mouth and hind feet."

Hollister (1919) records the following interesting notes from Heller's journal of the Rainey Expedition. "This morning near camp I saw several of the *Heterocephalus* throwing dirt out of their burrows. Little puffs of sand were coming out at intervals. The animal could not be seen and was apparently below the mouth of the burrow. . . . At 5 P. M. I saw several *Heterocephalus* throwing sand out of the burrows. I stood over one of the holes and watched. The animal pushed the dirt to the entrance with his head, then turned about and with his hind feet threw the dirt out, in a rapid puffy fashion, vertically, so that in falling it made a funnel-shaped pile about the hole. While he was thus throwing out the earth his tail could be seen wagging back and forth. Archers post: As we were approaching camp I saw one of the naked mole rats throwing sand out in the bright sunshine. They seem, after all, to have no definite time for work."

Allen (1912) has this to say of its habits: "It was captured alive by one of our Swahili boys who found it running about near our camp fire at night. He said that at first it had come near where he was sitting, but he paid no attention until shortly it returned, when he caught it. I have

found no mention of such above ground activity on the part of this animal. When handled, it gave vent to its displeasure in a few short coughs, but did not attempt to bite. . . . The soil along the river valley where it was captured is light and sandy, and suitable for burrowing. The elevation at this point is probably 3,000 to 4,000 feet, practicaliy at the upper limit of growth of the ivory-nut palm.

Dr. Ansorge (Thomas, 1903) noticed *Heterocephalus ansorgei* throwing out earth with its hind feet from a tiny circular hole at the bottom of a small crater-shaped mound of red earth. Dr. Dulio (Thomas, 1903) states that these animals in Italian Somaliland live in colonies of from fifty to one hundred in the sandy districts near the coast, that they burrowed very rapidly in the loose soil and for that reason were difficult to obtain.

Phillips (Thomas, 1885), in a letter to the British Museum concerning the habits of this rodent, has the following notes to contribute: "On being placed on the ground, it commenced to dig furiously, using its teeth to loosen the earth with; its eyes were tiny, and its ears simply holes in the side of its head. This little creature, called "Farumfer" by the Somali, throws up in places groups of miniature craters, which exactly represent volcanoes in active eruption. When the little beasts were at work I used frequently to watch them, and found that the loose earth from their excavations was brought to the bottom of the crater, and sent with great force into the air in a succession of rapid jerks, but they themselves never ventured forth from the shelter of their burrows."

Mrs. Delia J. Akeley, who captured the two Brooklyn Museum specimens of *Heterocephalus,* has the following field note: "They are very difficult to obtain. I worked with my boys day after day without success until I finally offered a reward of ten shillings for them. Then a little Somali boy sat over a hole the better part of a day before he finally speared two. Apparently they never come above the surface of the ground. They dig their runways in places two or three feet below the surface and their runways branch out from the main passage in all directions like the tributaries of a river. When the animals are working near the surface they can evidently hear a footstep overhead and although they have not been molested—for the natives were as much surprised as I was at their appearance—they rush back to the deep runway. They excavate and ventilate by cutting a round hole at the surface. This hole is about the size of a half dollar when finished and, regardless of the loose sand, it is a perfect circle and rarely varies in circumference. Through this

opening they throw up the loose sand and earth with their tiny feet which have stiff hairs sticking out from each toe. They work with lightning-like rapidity and when their feet are actually in action it looks like a miniature volcano in eruption. Strange to say, the sand is thrown up in such a way that a cone-shaped pile, a foot or more high, is formed around the hole. These strange little animals are perfectly at home in the water. One of those brought in was alive. I put it in a pail of water where it swam about and dived to the bottom for over two hours without any signs of drowning. I could not keep it there any longer for I was getting ready to move camp. Both of these specimens had, besides ants, some green vegetable matter and white roots of grass in their stomachs. Their stomachs were immense for so small a beast and the intestines were very small, both were queerly shaped it seemed to me. I found their kind active for about a mile west of the Kinna River and there they stopped abruptly and the common mole of East Africa took their place."

A further examination of the remaining parts of the alimentary tract of these two specimens reveal the remains of a beetle, a pupal case, a few seeds, several small rootlets and grasses and a small quantity of fine quartz pebbles.

Lönnberg (1912) has a few observations on this peculiar Naked Rat. He writes: "When one sees this quaint and naked being the first impression is that it is the new-born young of some large rodent. The nakedness, blindness, comparatively small feet but big head make it look like a foetus. But the ferociousness with which it at once bites anybody or anything that touches it, soon takes away the belief in its youth and harmlessness. It lives entirely under the ground, and its burrows appear to be long but mostly situated rather near the surface. Here and there the burrow has openings through which the earth is thrown out rapidly in thin squirts. Often quite a number of such little hills are situated near each other in rows about the burrows."

Discussion.

The rodent genus *Heterocephalus* has been placed in the Spalacinae, close to *Rhizomys,* by Alston, Brandt and Rüppell, while Thomas, Lönnberg, Drake-Brockman and Hollister place it in the Bathyergidae. From all the available material and with comparisons which have been made with allied forms, it seems unquestionable that the latter subfamily is correct. The genus has had four species and one subspecies, *Heterocephalus glaber, H. glaber progrediens, H. phillipsi, H. ansorgei* and *H.*

stygius. Thomas (1903) has made *Heterocephalus phillipsi* a new genus, *Fornarina phillipsi*, on the basis of its dentition, molar 3 being absent in this form. All the species, with the exception of *Fornarina*, are based on minor differences in size, together with slight differences in skull characters and the distribution of the various forms.

Hollister (1917), in a study of 12 specimens from one general region, found the characters used to separate these forms from *Heterocephalus glaber* were all accounted for by individual variation. He therefore groups all these previously described forms as synonyms of *H. glaber*.

The specimens I have studied agree essentially with *Heterocephalus ansorgei* described by Thomas. Externally they can not be separated from the three alcoholic specimens I have examined in the U. S. National Museum. But a careful study of the skeleton reveals essential differences from the specimen of *H. glaber* which was studied by the Italian anatomists, Parona and Cattaneo. Differences in the number of ribs, processes quite dissimilar and minor variations can not be accounted for too readily by individual variation. I do not believe it advisable at this time to make a species or even a subspecies with the scant material at hand, but with more material other investigators may find some well-defined forms.

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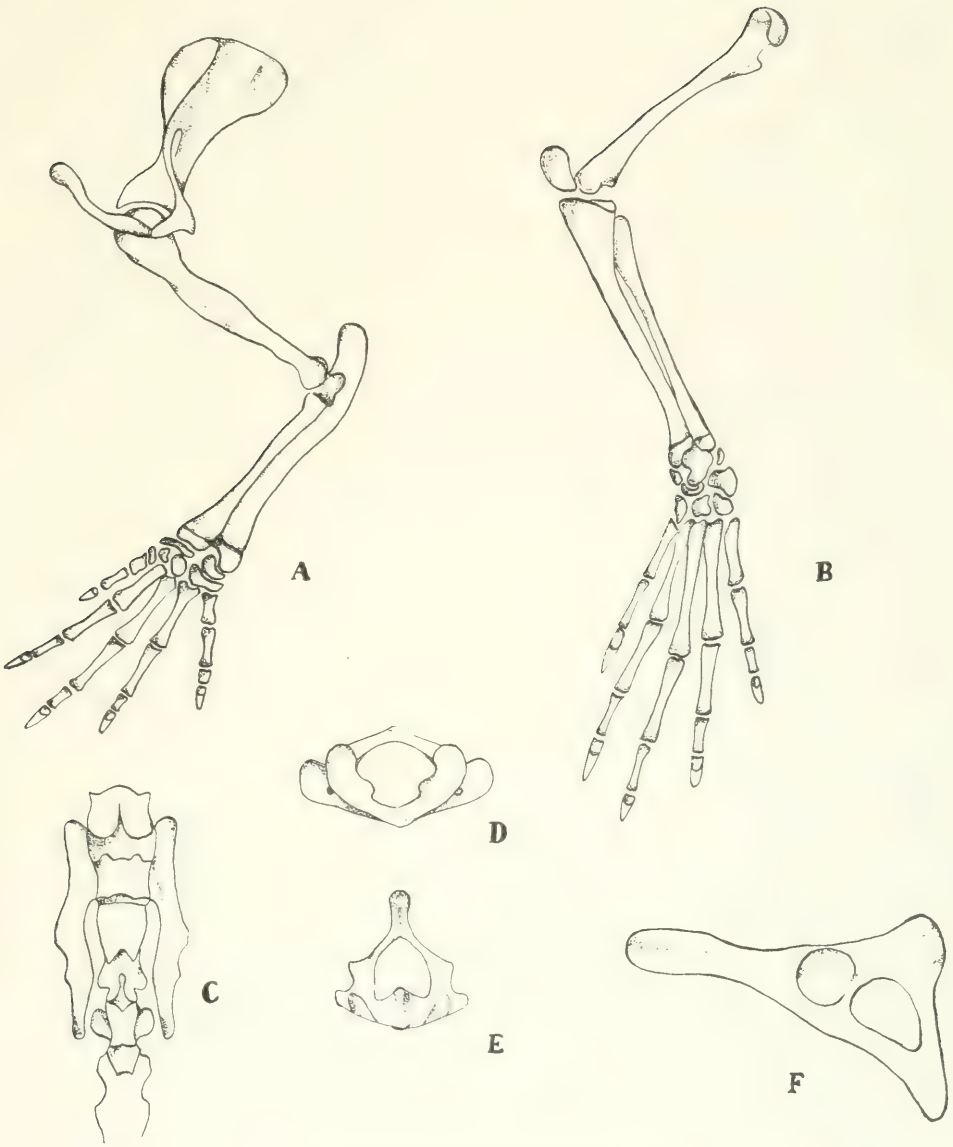
EXPLANATION OF PLATES.

Plate 1. Fig. A. Lateral aspect of left fore limb and shoulder. × 3.3.
Fig. B. Lateral aspect of left hind limb. × 3.3.
Fig. C. Dorsal view of sacral vertebrae, showing attachment of pelvic girdle. × 3.
Fig. D. Atlas. × 4.
Fig. E. Axis. × 4.
Fig. F. Left innominate bone. × 3.

Plate 2. Fig. A. Dorsal aspect of skull. × 3.
Fig. B. Ventral aspect of skull. × 3.
Fig. C. Lateral aspect of left mandible. × 3.
Fig. D. Plantar surface of right hind foot. × 3.
Fig. E. Pattern of the left upper series of molariform teeth. × 10.
Fig. F. Pattern of the left lower series of molariform teeth. × 10.
Fig. G. Sternum. × 4.

Plate 3. Lateral, ventral and dorsal view of *Heterocephalus glaber* × 3/2.

Plate 4. X-ray photographs of *Heterocephalus glaber*.
Dorsal & lateral aspect. Natural size. X-ray photograph by G. A. Maughan.



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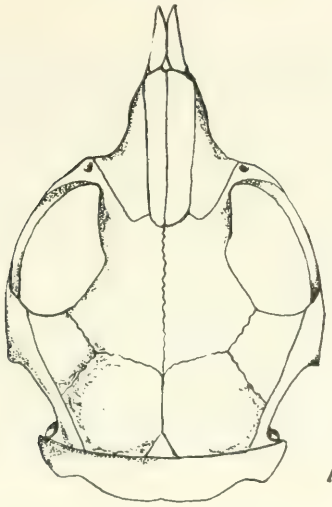

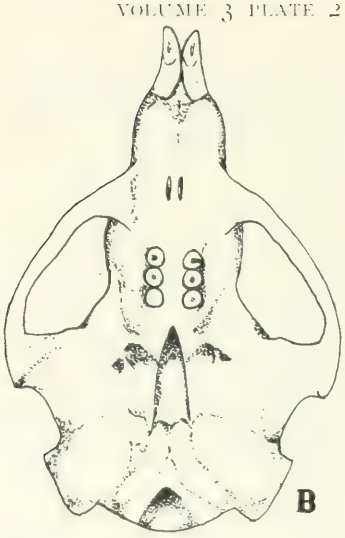

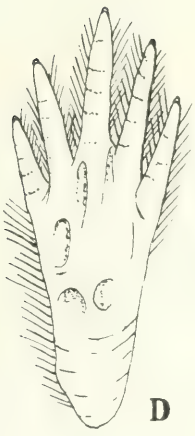

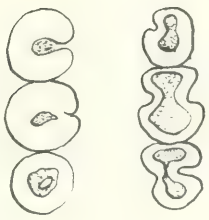

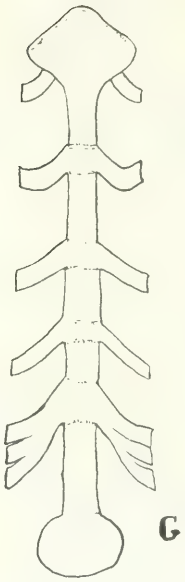

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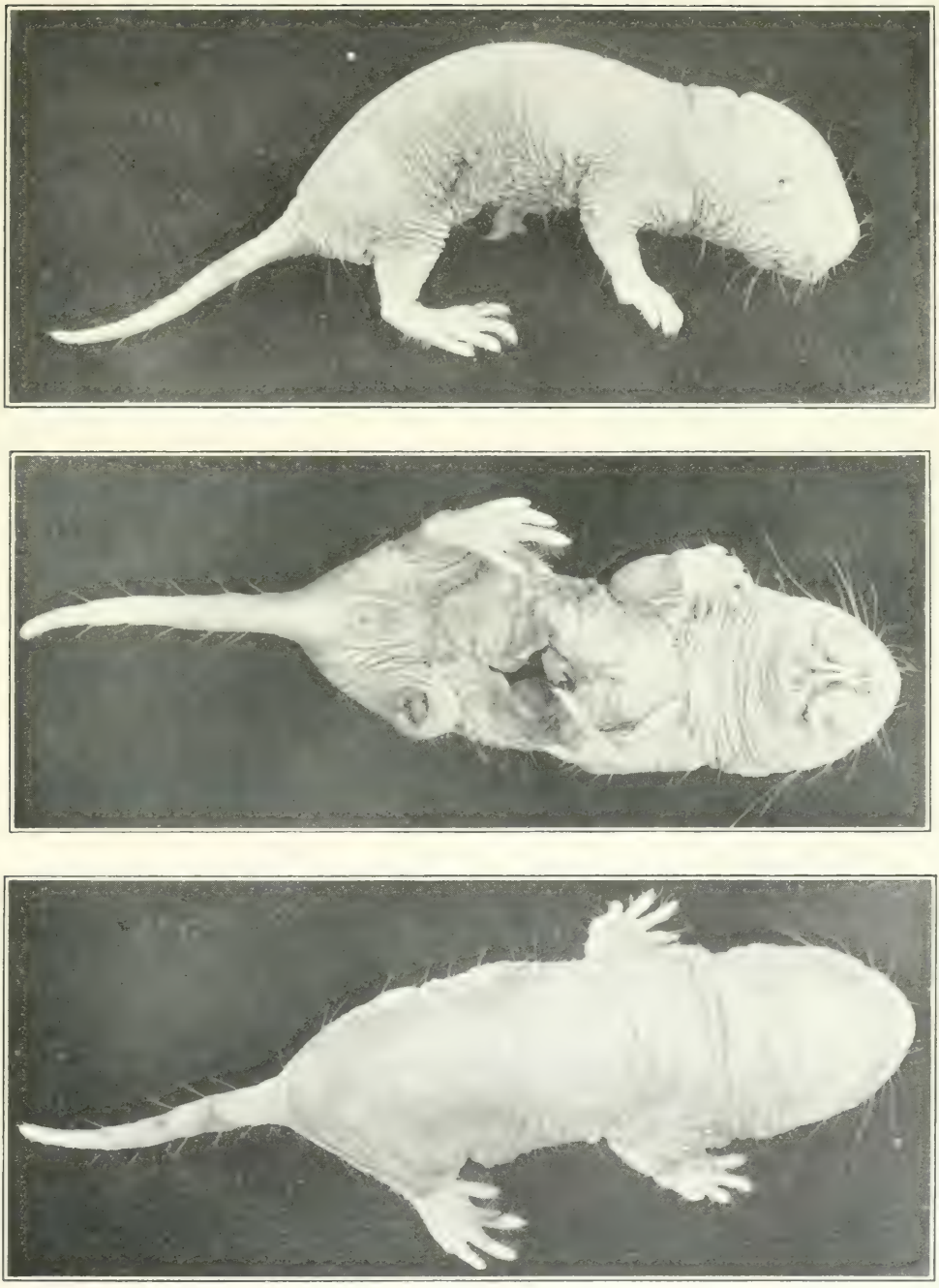

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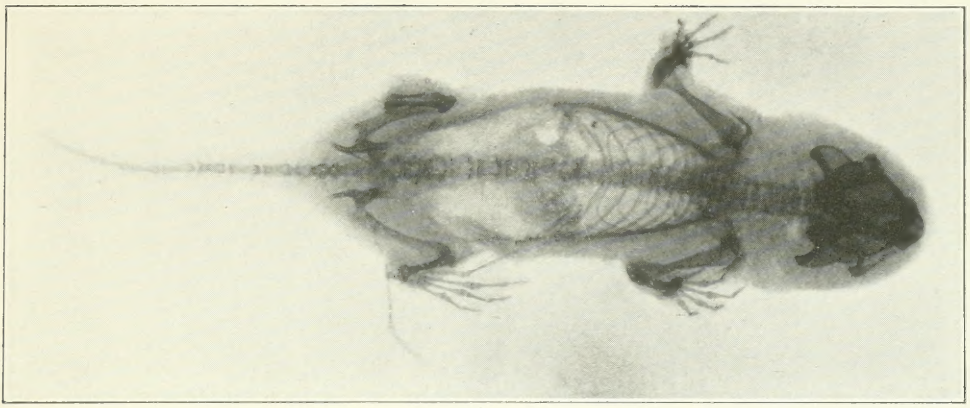

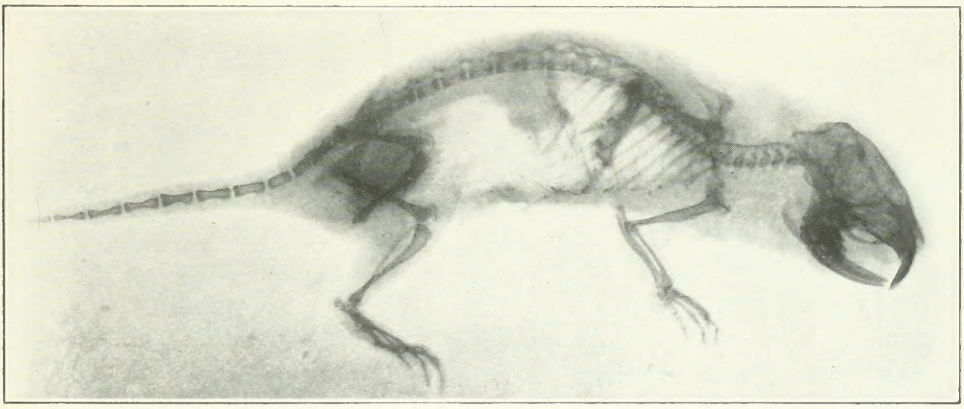

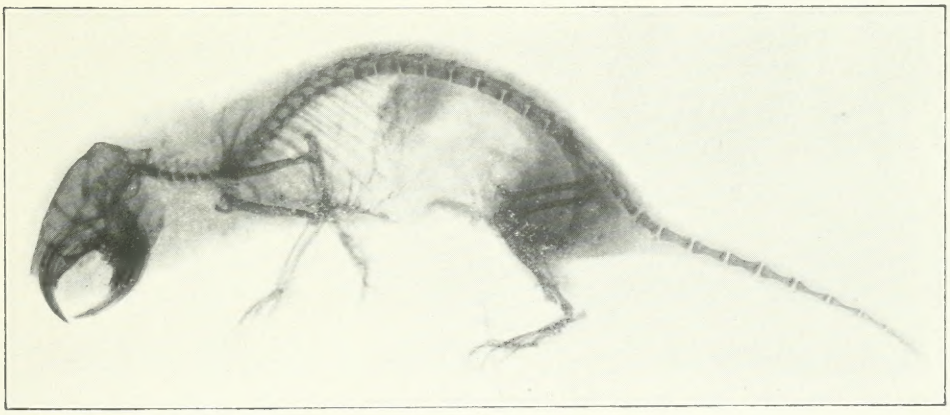

HETEROCERUS GLABER.

SCIENCE BULLETIN

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